

74LCX374 Low-Voltage Octal D Flip-Flop with 5V Tolerant Inputs and Outputs

General Description

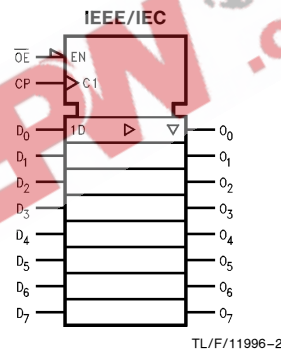
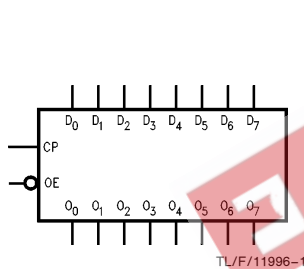
The LCX374 consists of eight D-type flip-flops featuring separate D-type inputs for each flip-flop and TRI-STATE® outputs for bus-oriented applications. A buffered clock (CP) and Output Enable (\overline{OE}) are common to all flip-flops. The LCX374 is designed for low-voltage (3.3V) V_{CC} applications with capability of interfacing to a 5V signal environment.

The LCX374 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

Features

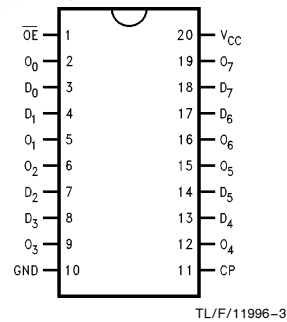
- 5V tolerant inputs and outputs
- 8.5 ns t_{PD} max, 10 μ A I_{CCQ} max
- Power-down high impedance inputs and outputs
- Supports live insertion/withdrawal
- 2.0V–3.6V V_{CC} supply operation
- ± 24 mA output drive
- Implements patented Quiet Series™ noise/EMI reduction circuitry
- Functionally compatible with the 74 series 374
- Latch-up performance exceeds 500 mA
- ESD performance:
 - Human Body Model > 2000V
 - Machine Model > 200V

Logic Symbols



Connection Diagram

Pin Assignment for SOIC, SSOP and TSSOP



Pin Names	Description
D ₀ –D ₇	Data Inputs
CP	Clock Pulse Input
\overline{OE}	Output Enable Input
O ₀ –O ₇	TRI-STATE Outputs

	SOIC JEDEC	SOIC EIAJ	SSOP Type II	TSSOP JEDEC
Order Number	74LCX374WM 74LCX374WMX	74LCX374SJ 74LCX374SJX	74LCX374MSA 74LCX374MSAX	74LCX374MTC 74LCX374MTCX
See NS Package Number	M20B	M20D	MSA20	MTC20

TRI-STATE® is a registered trademark of National Semiconductor Corporation.
Quiet Series™ is a trademark of National Semiconductor Corporation.

Functional Description

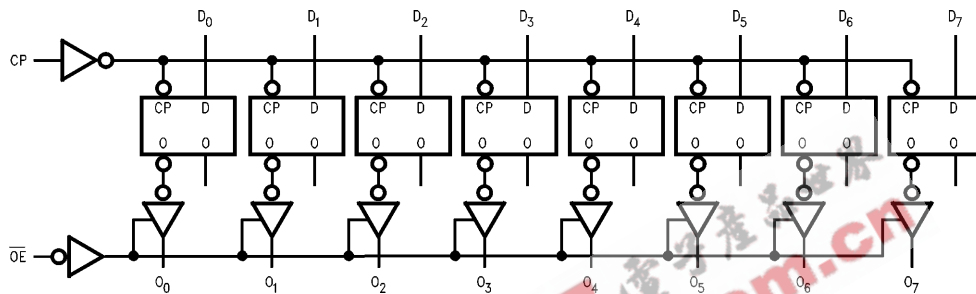
The LCX374 consists of eight edge-triggered flip-flops with individual D-type inputs and TRI-STATE true outputs. The buffered clock and buffered Output Enable are common to all flip-flops. The eight flip-flops will store the state of their individual D inputs that meet the setup and hold time requirements on the LOW-to-HIGH Clock (CP) transition. With the Output Enable (\overline{OE}) LOW, the contents of the eight flip-flops are available at the outputs. When the \overline{OE} is HIGH, the outputs go to the high impedance state. Operation of the \overline{OE} input does not affect the state of the flip-flops.

Truth Table

D_n	Inputs		Outputs
	CP	\overline{OE}	O_n
H	↗	L	H
L	↗	L	L
X	L	L	O_0
X	X	H	Z

H = HIGH Voltage Level
 L = LOW Voltage Level
 X = Immaterial
 Z = High Impedance
 ↗ = LOW-to-HIGH Transition
 O_0 = Previous O_0 before HIGH to LOW of CP

Logic Diagram



TL/F/11996-4

Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Symbol	Parameter	Value	Conditions	Units
V_{CC}	Supply Voltage	-0.5 to +7.0		V
V_I	DC Input Voltage	-0.5 to +7.0		V
V_O	DC Output Voltage	-0.5 to +7.0	Output in TRI-STATE	V
		-0.5 to $V_{CC} + 0.5$	Output in High or Low State (Note 2)	V
I_{IK}	DC Input Diode Current	-50	$V_I < GND$	mA
I_{OK}	DC Output Diode Current	-50	$V_O < GND$	mA
		+50	$V_O > V_{CC}$	
I_O	DC Output Source/Sink Current	± 50		mA
I_{CC}	DC Supply Current per Supply Pin	± 100		mA
I_{GND}	DC Ground Current per Ground Pin	± 100		mA
T_{STG}	Storage Temperature	-65 to +150		$^{\circ}C$

Note 1: The Absolute Maximum Ratings are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the Absolute Maximum Ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Note 2: I_O Absolute Maximum Rating must be observed.

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Units	
V_{CC}	Supply Voltage	Operating	2.0	3.6	V
		Data Retention	1.5	3.6	
V_I	Input Voltage	0	5.5	V	
V_O	Output Voltage	HIGH or LOW State	0	V_{CC}	V
		TRI-STATE	0	5.5	
I_{OH}/I_{OL}	Output Current	$V_{CC} = 3.0V-3.6V$ $V_{CC} = 2.7V$		± 24 ± 12	mA
T_A	Free-Air Operating Temperature	-40	85	$^{\circ}C$	
$\Delta t/\Delta V$	Input Edge Rate, $V_{IN} = 0.8V-2.0V$, $V_{CC} = 3.0V$	0	10	ns/V	

DC Electrical Characteristics

Symbol	Parameter	Conditions	V_{CC} (V)	$T_A = -40^{\circ}C$ to $+85^{\circ}C$		Units
				Min	Max	
V_{IH}	HIGH Level Input Voltage		2.7-3.6	2.0		V
V_{IL}	LOW Level Input Voltage		2.7-3.6		0.8	V
V_{OH}	HIGH Level Output Voltage	$I_{OH} = -100 \mu A$	2.7-3.6	$V_{CC} - 0.2$		V
		$I_{OH} = -12 mA$	2.7	2.2		V
		$I_{OH} = -18 mA$	3.0	2.4		V
		$I_{OH} = -24 mA$	3.0	2.2		V
V_{OL}	LOW Level Output Voltage	$I_{OL} = 100 \mu A$	2.7-3.6		0.2	V
		$I_{OL} = 12 mA$	2.7		0.4	V
		$I_{OL} = 16 mA$	3.0		0.4	V
		$I_{OL} = 24 mA$	3.0		0.55	V
I_I	Input Leakage Current	$0 \leq V_I \leq 5.5V$	2.7-3.6		± 5.0	μA
I_{OZ}	TRI-STATE Output Leakage	$0 \leq V_O \leq 5.5V$ $V_I = V_{IH}$ or V_{IL}	2.7-3.6		± 5.0	μA
I_{OFF}	Power-Off Leakage Current	V_I or $V_O = 5.5V$	0		10	μA
I_{CC}	Quiescent Supply Current	$V_I = V_{CC}$ or GND	2.7-3.6		10	μA
		$3.6V \leq V_I, V_O \leq 5.5V$	2.7-3.6		± 10	μA
ΔI_{CC}	Increase in I_{CC} per Input	$V_{IH} = V_{CC} - 0.6V$	2.7-3.6		500	μA

AC Electrical Characteristics

Symbol	Parameter	$T_A = -40^{\circ}\text{C to } +85^{\circ}\text{C}$				Units
		$V_{CC} = 3.3\text{V} \pm 0.3\text{V}$		$V_{CC} = 2.7\text{V}$		
		Min	Max	Min	Max	
f_{MAX}	Maximum Clock Frequency	150				MHz
t_{PHL} t_{PLH}	Propagation Delay CP to O_n	1.5 1.5	8.5 8.5	1.5 1.5	9.5 9.5	ns
t_{PZL} t_{PZH}	Output Enable Time	1.5 1.5	8.5 8.5	1.5 1.5	9.5 9.5	ns
t_{PLZ} t_{PHZ}	Output Disable Time	1.5 1.5	7.5 7.5	1.5 1.5	8.5 8.5	ns
t_s	Setup Time	2.5		2.5		ns
t_H	Hold Time	1.5		1.5		ns
t_W	Pulse Width	3.3		3.3		ns
t_{OSHL} t_{OSLH}	Output to Output Skew (Note 1)		1.0 1.0			ns

Note 1: Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH to LOW (t_{OSHL}) or LOW to HIGH (t_{OSLH}).

Dynamic Switching Characteristics

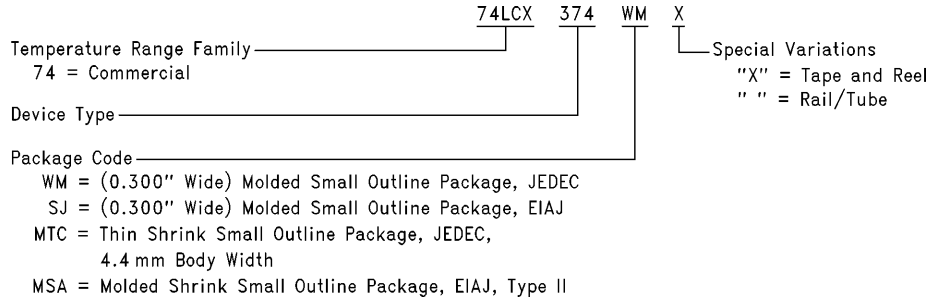
Symbol	Parameter	Conditions	V_{CC} (V)	$T_A = 25^{\circ}\text{C}$	Units
				Typical	
V_{OLP}	Quiet Output Dynamic Peak V_{OL}	$C_L = 50\text{ pF}, V_{\text{IH}} = 3.3\text{V}, V_{\text{IL}} = 0\text{V}$	3.3	0.8	V
V_{OLV}	Quiet Output Dynamic Valley V_{OL}	$C_L = 50\text{ pF}, V_{\text{IH}} = 3.3\text{V}, V_{\text{IL}} = 0\text{V}$	3.3	-0.8	V

Capacitance

Symbol	Parameter	Conditions	Typical	Units
C_{IN}	Input Capacitance	$V_{CC} = \text{Open}, V_I = 0\text{V or } V_{CC}$	7	pF
C_{OUT}	Output Capacitance	$V_{CC} = 3.3\text{V}, V_I = 0\text{V or } V_{CC}$	8	pF
C_{PD}	Power Dissipation Capacitance	$V_{CC} = 3.3\text{V}, V_I = 0\text{V or } V_{CC}, F = 10\text{ MHz}$	25	pF

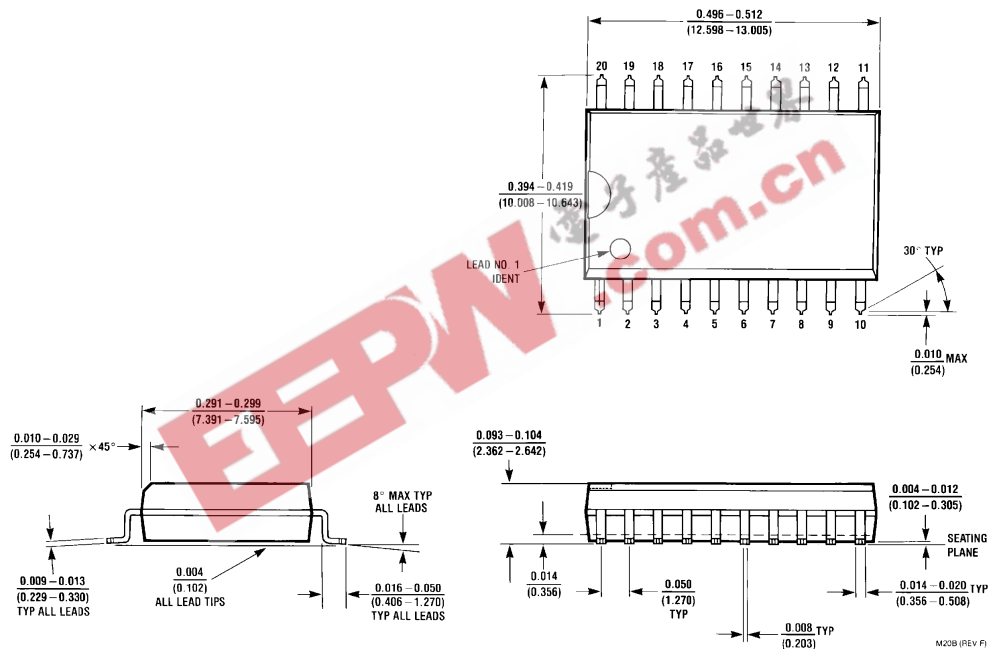
74LCX374 Ordering Information

The device number is used to form part of a simplified purchasing code where the package type and temperature range are defined as follows:



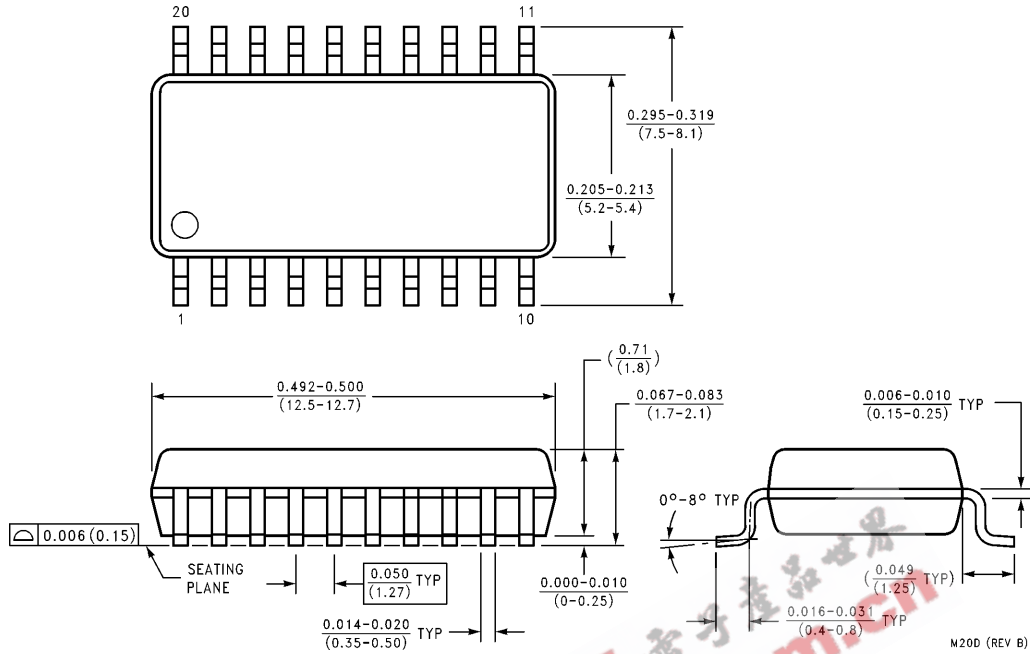
TL/F/11996-5

Physical Dimensions inches (millimeters) unless otherwise noted



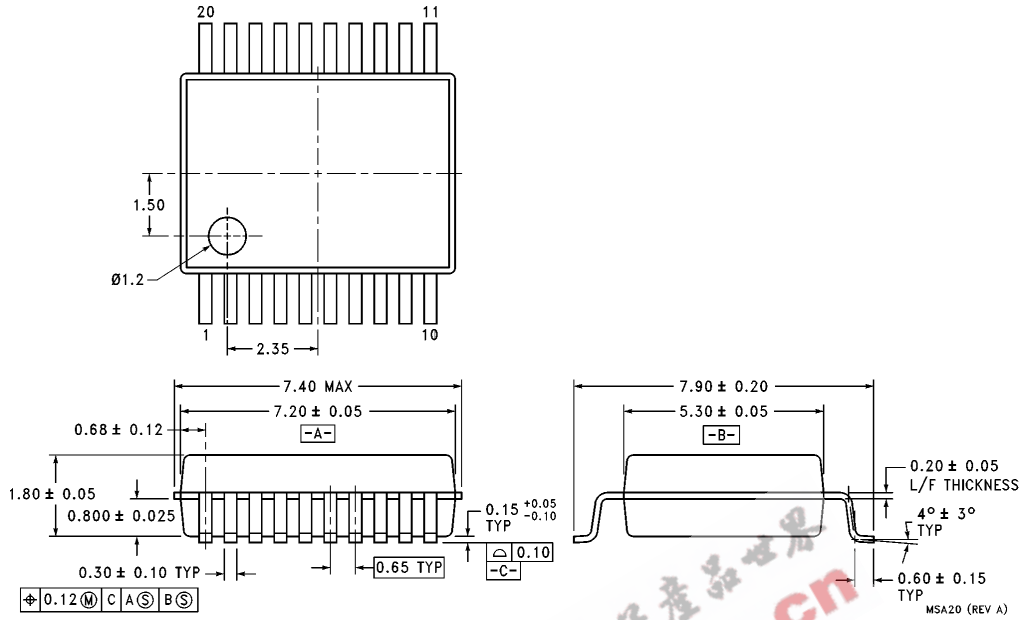
20-Lead (0.300" Wide) Molded Small Outline Package, JEDEC
Order Number 74LCX374WM or 74LCX374WMX
NS Package Number M20B

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



20-Lead (0.300" Wide) Molded Small Outline Package, EIAJ
Order Number 74LCX374SJ or 74LCX374SJX
NS Package Number M20D

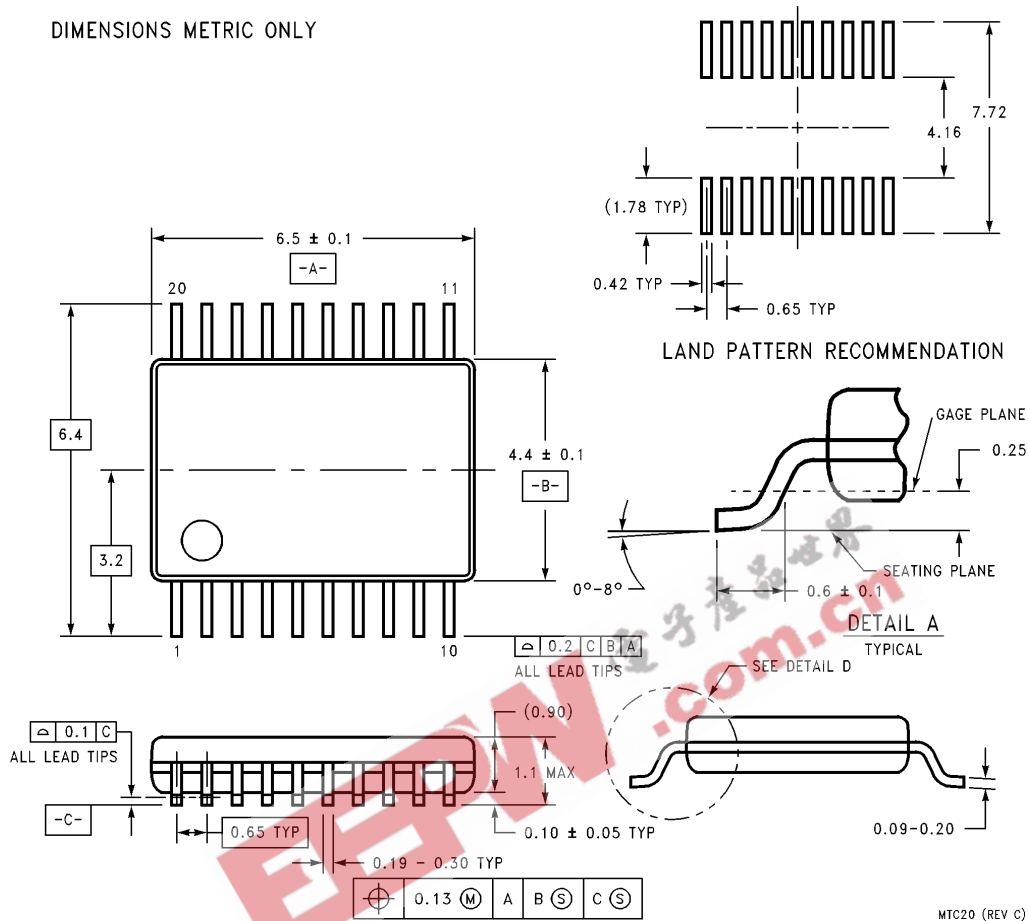
Physical Dimensions All dimensions are in millimeters (Continued)



20-Lead Molded Shrink Small Outline Package, EIAJ, Type II
Order Number 74LCX374MSA or 74LCX374MSAX
NS Package Number MSA20

Physical Dimensions All dimensions are in millimeters (Continued)

DIMENSIONS METRIC ONLY



20-Lead Thin Shrink Small Outline Package, JEDEC
Order Number 74LCX374MTC or 74LCX374MTCX
NS Package Number MTC20

MTC20 (REV C)

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

National Semiconductor Corporation
Americas
 Tel: 1(800) 272-9959
 Fax: 1(800) 737-7018
 Email: support@nsc.com
<http://www.national.com>

National Semiconductor Europe
 Fax: +49 (0) 180-530 85 86
 Email: europe.support@nsc.com
 Deutsch Tel: +49 (0) 180-530 85 85
 English Tel: +49 (0) 180-532 78 32
 Français Tel: +49 (0) 180-532 93 58
 Italiano Tel: +49 (0) 180-534 16 80

National Semiconductor Southeast Asia
 Fax: (852) 2376 3901
 Email: sea.support@nsc.com

National Semiconductor Japan Ltd.
 Tel: 81-3-5620-7561
 Fax: 81-3-5620-6179